Real-Time Water Quality Deployment Report

Rattling Brook Network

October 14th to November 17th, 2010

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

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General

- Department of Environment and Conservation staff monitors the real-time web pages consistently.
- This deployment report interprets data from October 14th to November 17th, 2010 – a period of 33 days.
- Over this time period, only a single communication dropout occurred. This did not have any impact on data interpretation.

Maintenance and Calibration of Instrument

- As part of the Quality Assurance and Quality Control protocol (QAQC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.
  - Upon deployment, a QA/QC Sonde is temporarily deployed along side the Field Sonde. Values for temperature and dissolved oxygen are compared between the two instruments. A grab sample is taken to compare with the Field Sonde for specific conductivity, pH and turbidity parameters. Based on the degree of difference between parameters recorded by the Field Sonde, QAQC Sonde and grab sample a qualitative statement is made on the data quality in Table 1 upon Deployment.
  - At the end of a deployment period, readings are taken in the water body from the Field Sonde before and after a thorough cleaning in order to assess the degree of biofouling. During calibration in the laboratory, an assessment of calibration drift is made and the two error values are combined to give Total Error (T_e). If T_e exceeds a predetermined data correction criterion, a correction based on T_e is applied to the dataset using linear interpolation. Based on the value for T_e, a qualitative statement is also made on the data quality in Table 1 upon Removal.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Rattling Brook Big Pond	October 14, 2010	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	November 17, 2010	Removal	Good	Fair	Good	Excellent	Excellent
Rattling Brook below Bridge	October 14, 2010	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	November 17, 2010	Removal	Excellent	Fair	Excellent	Excellent	Excellent
Rattling Brook below Plant Discharge	October 14, 2010	Deployment	Good	Good	Excellent	Excellent	Excellent
	November 17, 2010	Removal	Excellent	Excellent	Excellent	Excellent	Good

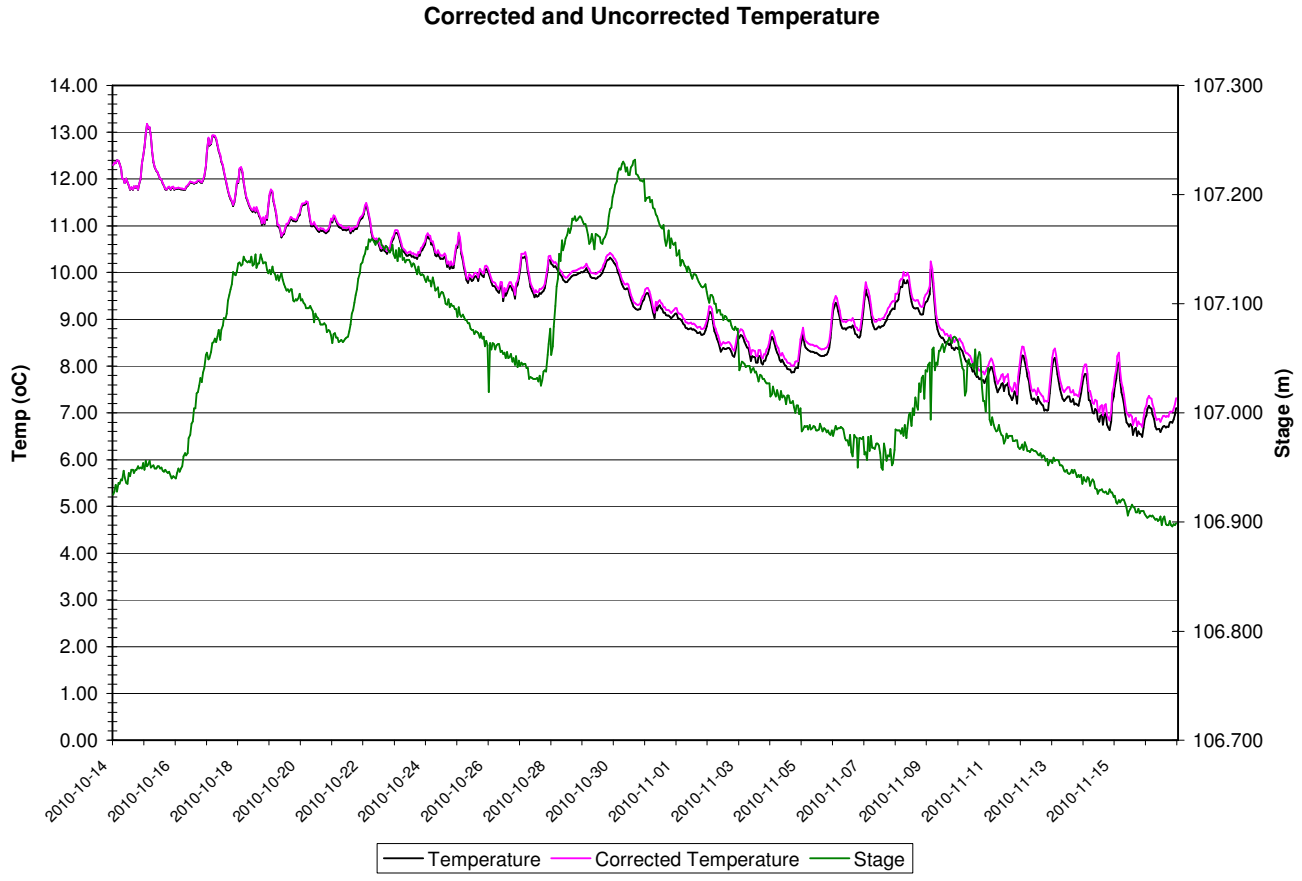
- All parameters were ranked from “Good” to “Excellent” except for pH which was ranked as “Fair” at the end of deployment. This might indicate that the pH sensor is somewhat more susceptible to error than other parameters over the course of the 33 day deployment.

Data Interpretation

Rattling Brook Big Pond

- A Total Error of 0.22°C led to a correction for water temperature. The figure below depicts raw and corrected data.
- A distinct downward trend is present throughout this deployment period with a brief rise in temperature from November 5th to November 9th. The buffering effect of Big Pond moderates changes in water temperature to a great deal. Similar figures for below Bridge and Plant Discharge figures show increasing tendency to be affected by air temperatures and the range in values become much broader as water progresses further through the Rattling Brook system.
- Water temperature at Big Pond ranged from 13.17 to 6.49°C with a median of 9.52°C.

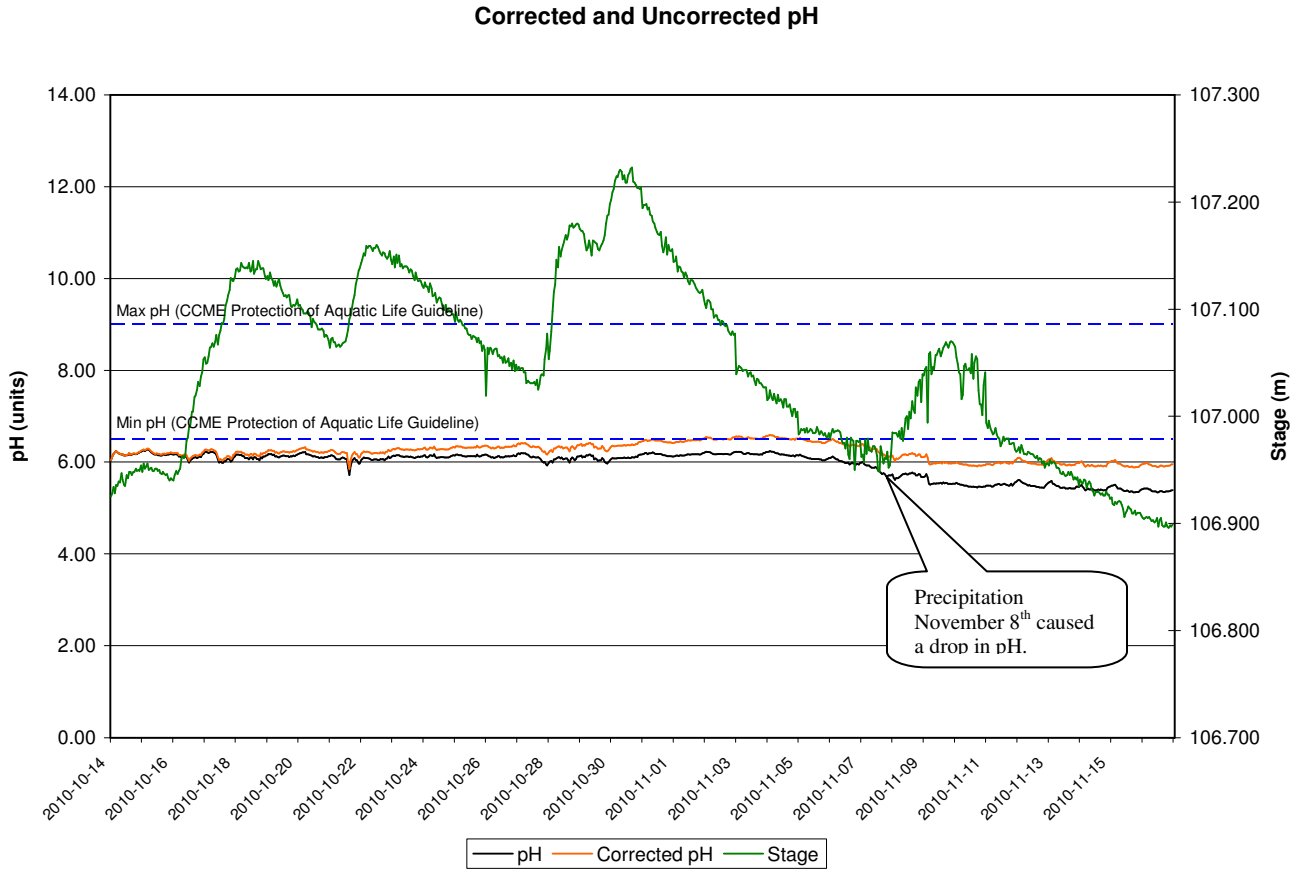
Figure 1: Water Temperature at Rattling Brook Big Pond from October 14 to November 17, 2010



- pH was corrected by 0.57 units for this deployment period due to total error exceeding the data correction criterion.
- Corrected pH ranged from 5.85 to 6.59 with a median value of 6.23 units. This means that more than 50% of recorded pH values were found to be below the CCME Guideline of 6.5 for the protection of aquatic life. This is expected in the Rattling Brook system given the geochemistry of the area.

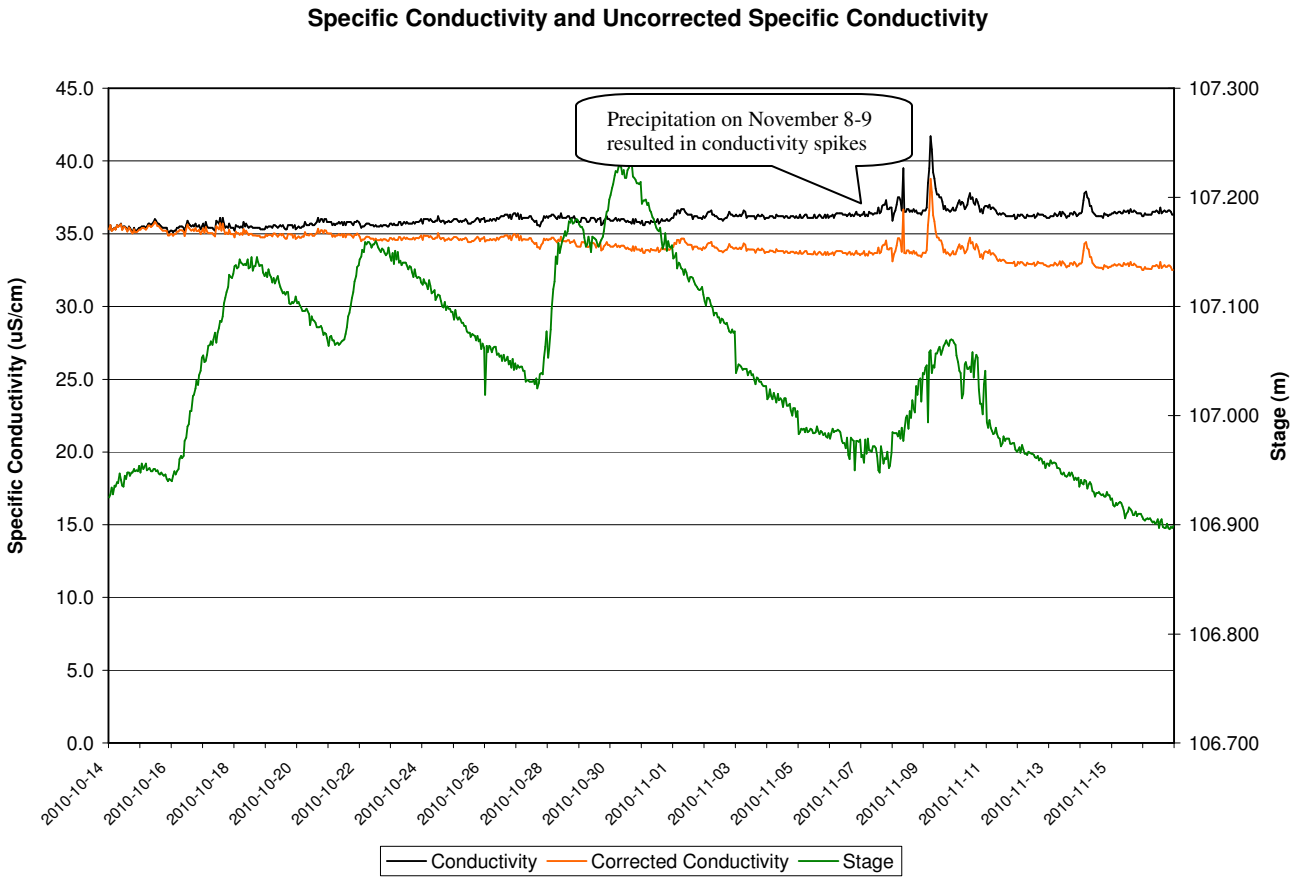
- On November 8 – 9, 22.3 mm of precipitation fell causing a mild acidification to Rattling Brook Big Pond. A drop in pH from 6.33 to 6.03 occurred in 20 hours. pH did not recover following the heavy rainfall and remained relative low until removal on November 17th.

Figure 2: pH at Rattling Brook Big Pond from October 14 to November 17, 2010



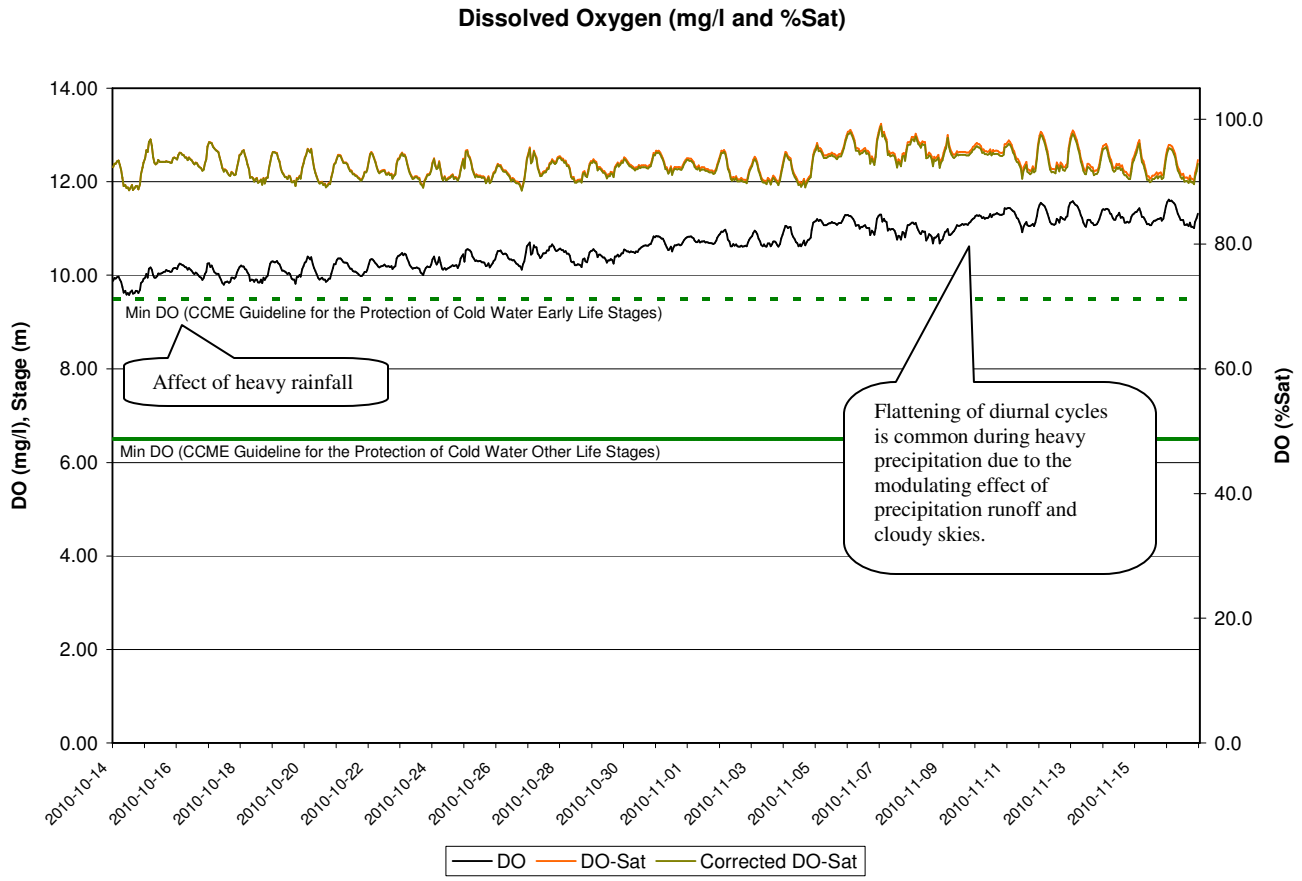
- Total Error exceeded the data correction criterion during this deployment, resulting in a -3.80 µS/cm correction to specific conductivity. Raw and corrected data is presented below.
- According to corrected data, a marginally falling trend is observed. Values ranged from 32.5 to 38.8 µS/cm during heavy precipitation on November 8th and 9th. A median value of 34.2 µS/cm was calculated.

Figure 3: Specific Conductivity at Rattling Brook Big Pond from October 14 to November 17, 2010



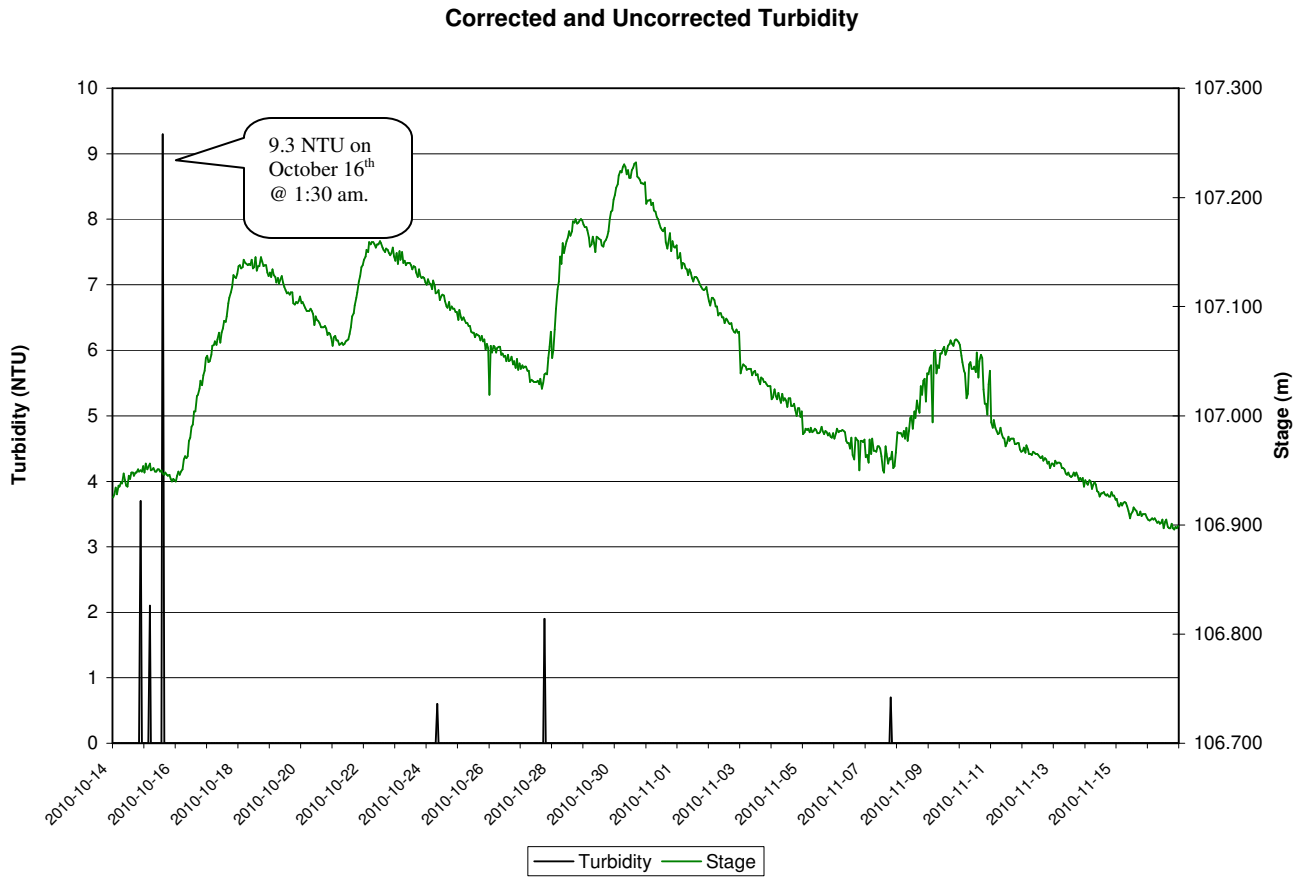
- Dissolved oxygen saturation was essentially stable for this time frame with no clear up- or downward trend. Saturation ranged from 88.6 to 98.9% with a median value of 92.4%. These values are well within the expectation for Rattling Brook Big Pond.
- Oxygen concentrations varied from 9.58 to 11.62 mg/l in an increasing fashion. This mirrors the falling water temperatures also recorded during this deployment period.
- A median oxygen concentration of 10.62 mg/l indicates that more than 50% of the recordings are greater than the CCME Guideline of 9.5 mg/l for the protection of Early Life Stage cold water biota. All values were greater than the guideline of 6.5 mg/l for the protection of Other Life Stage cold water biota.

Figure 4: Dissolved Oxygen at Rattling Brook Big Pond from October 14 to November 17, 2010



- Turbidity was very low at Rattling Brook Big Pond from October 14th to November 17th. A handful of short-duration spikes reached upper limits of 9.3 with most values registering as 0.0 NTU. The largest of the peaks occurred on October 16th at 1:30 am during 42.6 mm of precipitation.

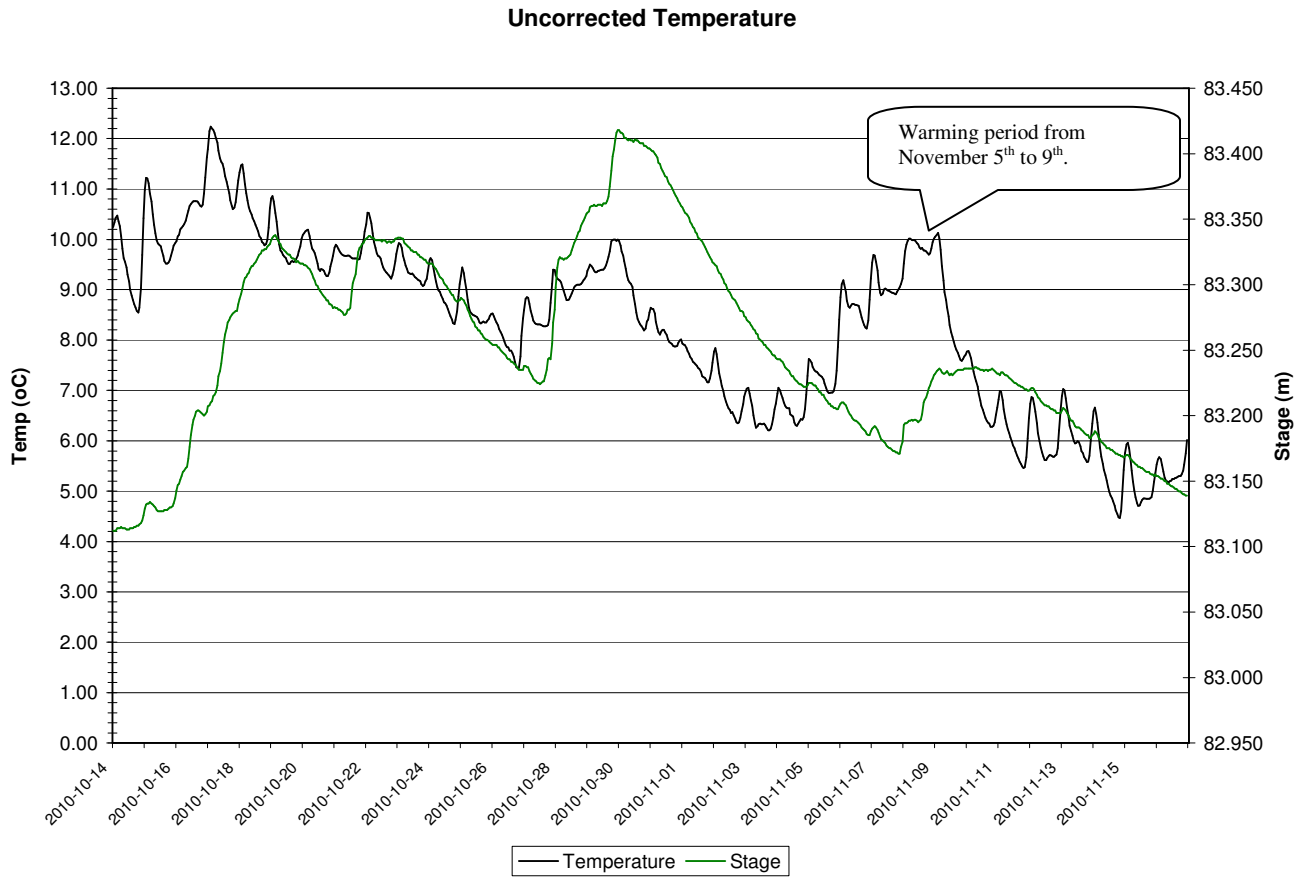
Figure 5: Turbidity at Rattling Brook Big Pond from October 14 to November 17, 2010



Rattling Brook below Bridge

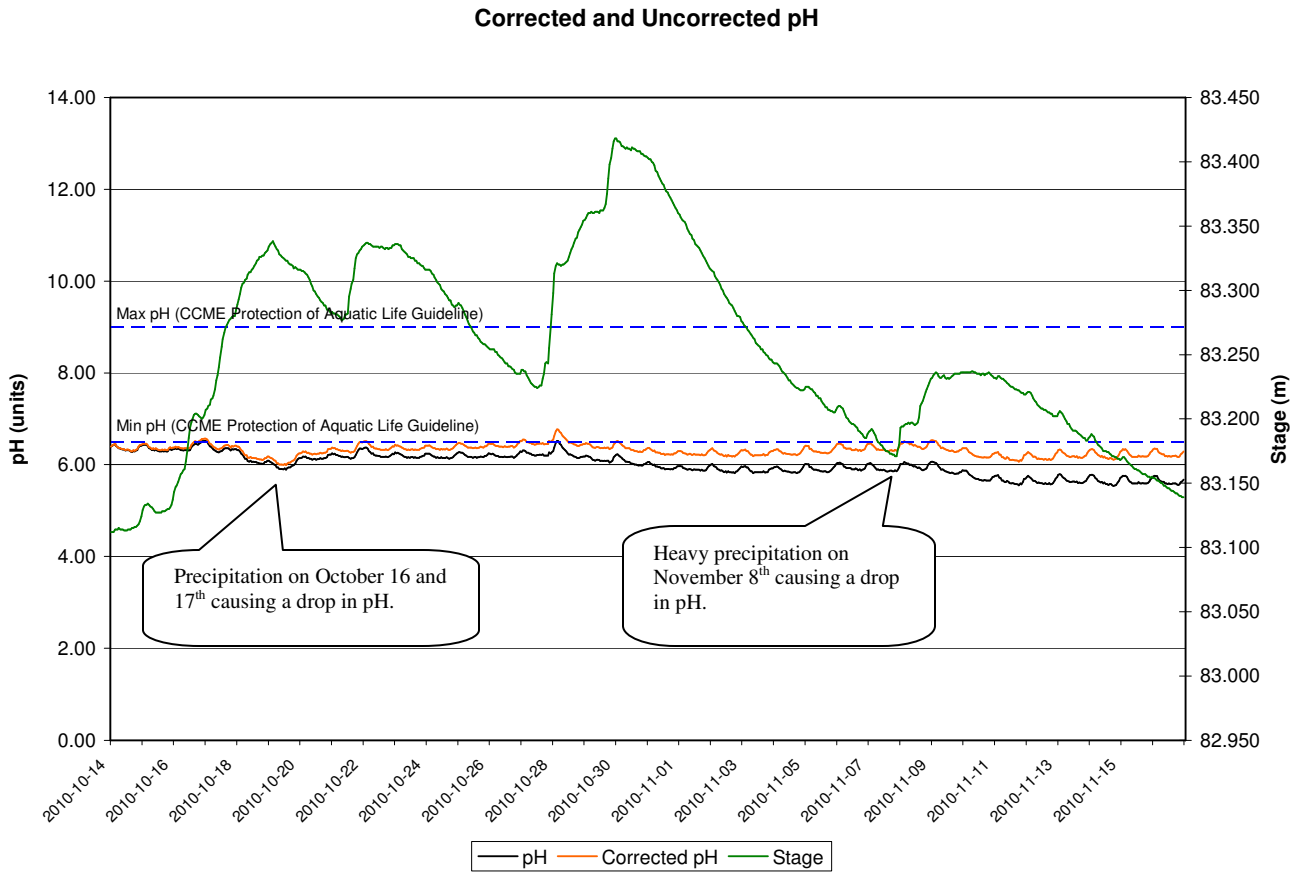
- Water temperature is not corrected for the deployment at Rattling Brook below Bridge since the data correction criterion was not exceeded.
- Much like the trend in water temperature seen at Big Pond, a month-long decline in temperature is seen from October 14th to November 17th, with a brief interruption during a warming period between November 5th and 9th.
- Water temperature ranged from 12.24 to 4.47°C with a median temperature of 8.62°C. Water temperatures at this station were somewhat cooler than temperature recorded at Big Pond station upstream.

Figure 6: Water Temperature at Rattling Brook below Bridge from October 14 to November 17, 2010



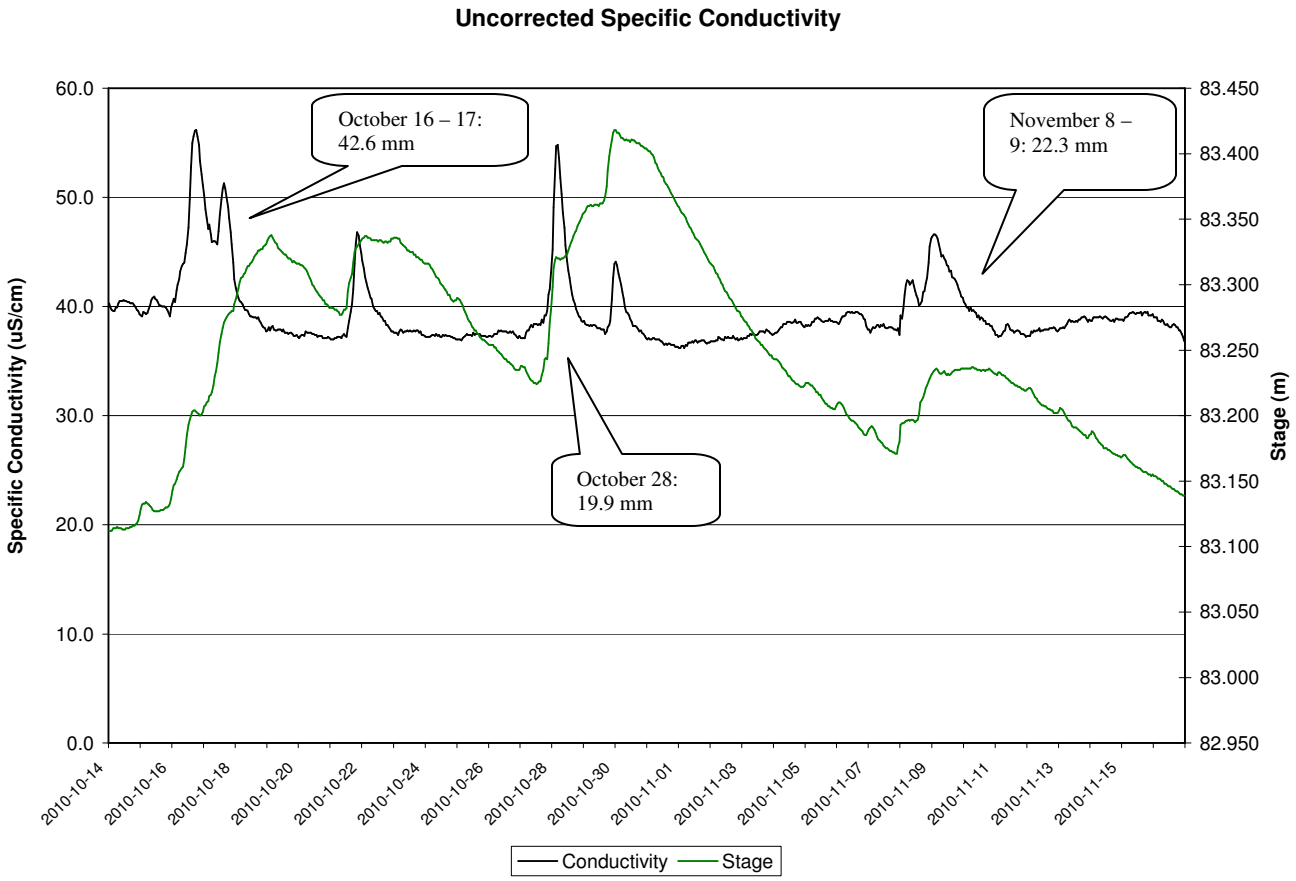
- Corrections to pH for this deployment indicate that there is no major up- or downward trend in pH at this station. An examination of the raw data may indicate that there is a downward trend; however, this may be simply due to calibration drift in the pH sensor for instrument s/n 44604.
- Corrected pH ranged from 5.85 to 6.59 with a median value of 6.23. Most values are below the CCME Guideline of 6.5 for the protection of aquatic life. This is expected in the Rattling Brook system given the geochemistry of the area.

Figure 7: pH at Rattling Brook below Bridge from October 14 to November 17, 2010



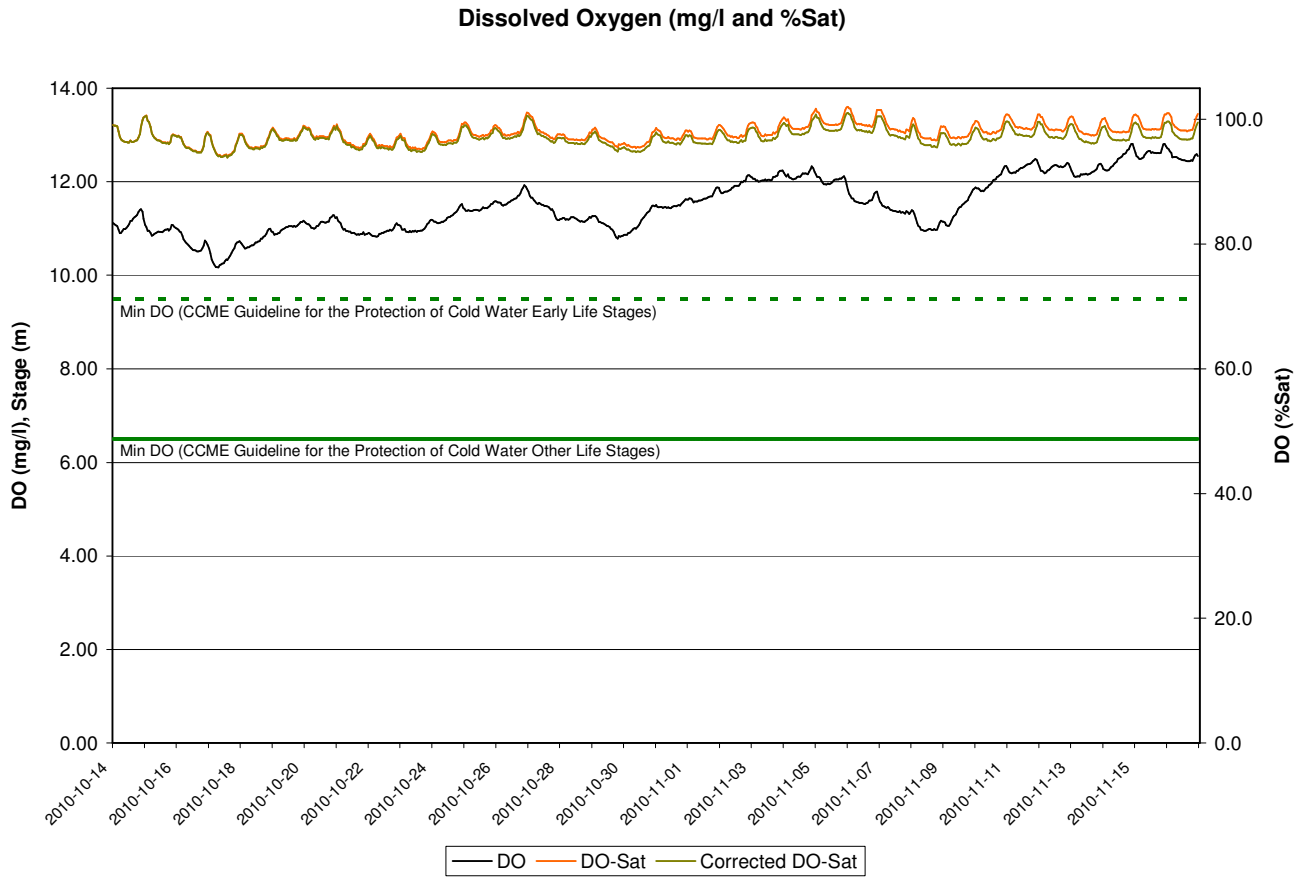
- Specific Conductivity was not corrected for this deployment period since the total error did not exceed the data correction criterion. Raw data is presented in the figure below.
- An obvious trend is not observed in conductivity at this station. Values range from 36.2 to a high of 56.2 µS/cm on October 17th at 6:30am. The median value was calculated to be 38.3 µS/cm – in line with expectations at this station.
- All large peaks are associated with precipitation events as outlined in the Appendix.

Figure 8: Specific Conductivity at Rattling Brook below Bridge from October 14 to November 17, 2010



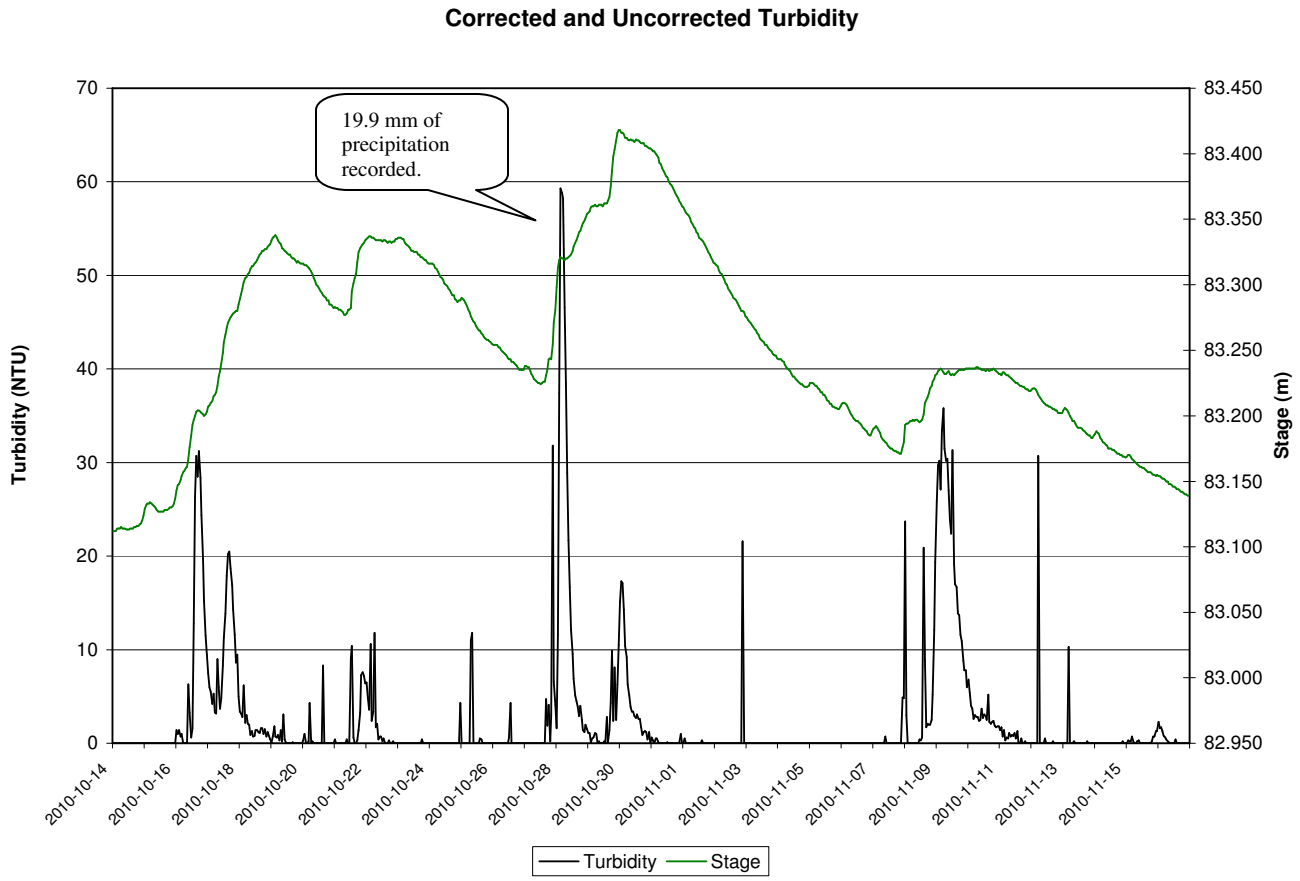
- Dissolved oxygen saturation ranged from 94.0 to 102.0% from October 14th to November 17th. The median value was found to be 97.7% indicating a good state of health in terms of oxygen saturation.
- Oxygen concentration at below Bridge station ranged from 10.17 to 12.81 mg/l with a median value of 11.44 mg/l. Most values are greater than the minimum CCME Guideline of 9.5 mg/l for the protection of Early Life Stage cold water biota. The concentration of oxygen increases as time progresses in conjunction with decreasing water temperature.

Figure 9: Dissolved Oxygen at Rattling Brook below Bridge from October 14 to November 17, 2010



- Turbidity was found to be highly variable during this deployment period. This characteristic is common amongst other rivers in the region that were struck hard during Hurricane Igor. The extreme flow during the storm impacted river bank stability by removing shrubs and grasses that held silt and soil. The result is that an inordinate amount of silt enters the river channel during small fluctuations in water level and flow.
- Turbidity ranged from 0.0 to 59.3 NTU with a median of 0.0 NTU. The deployment maximum of 59.3 NTU occurred on October 28th at 3:30 pm.

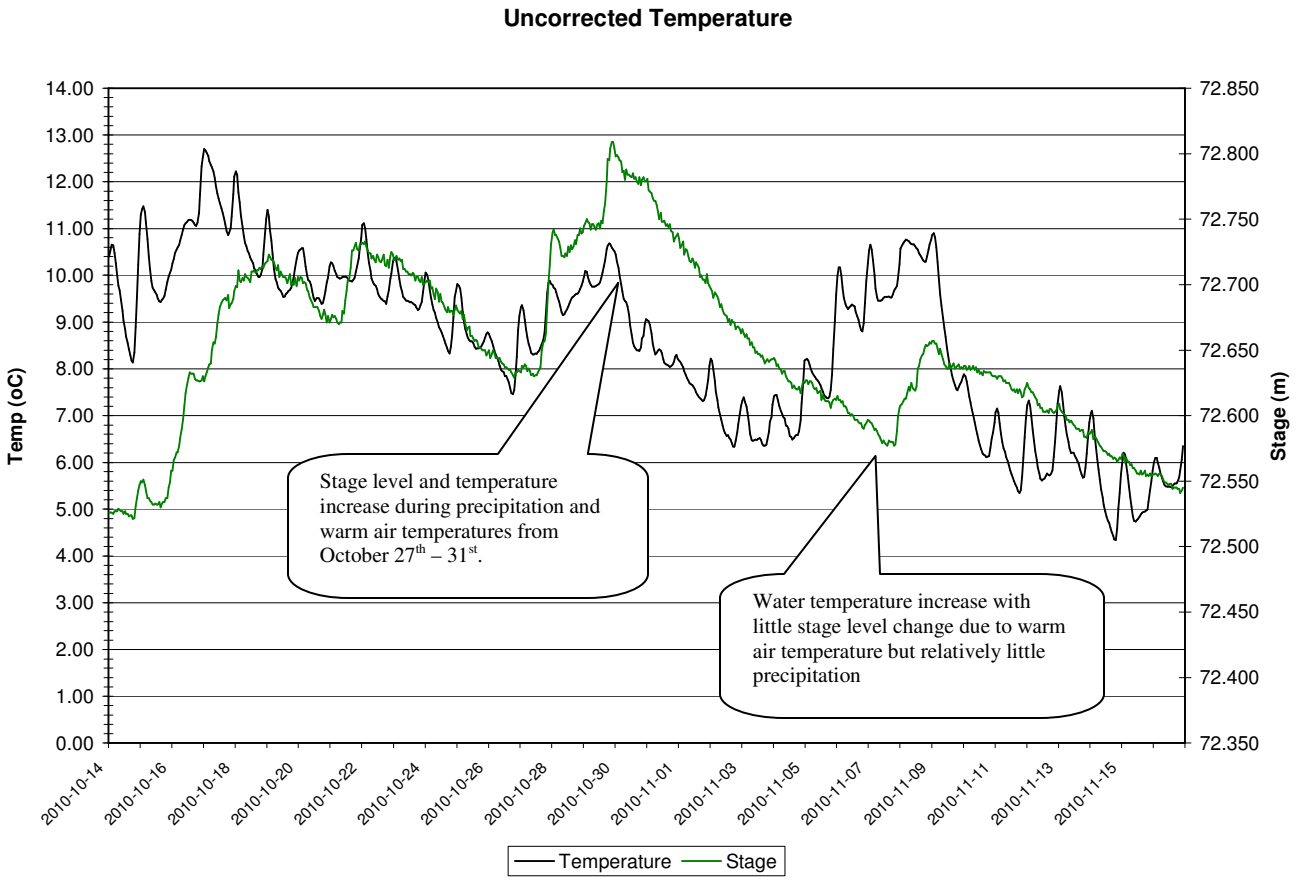
Figure 10: Turbidity at Rattling Brook below Bridge from October 14 to November 17, 2010



Rattling Brook below Plant Discharge

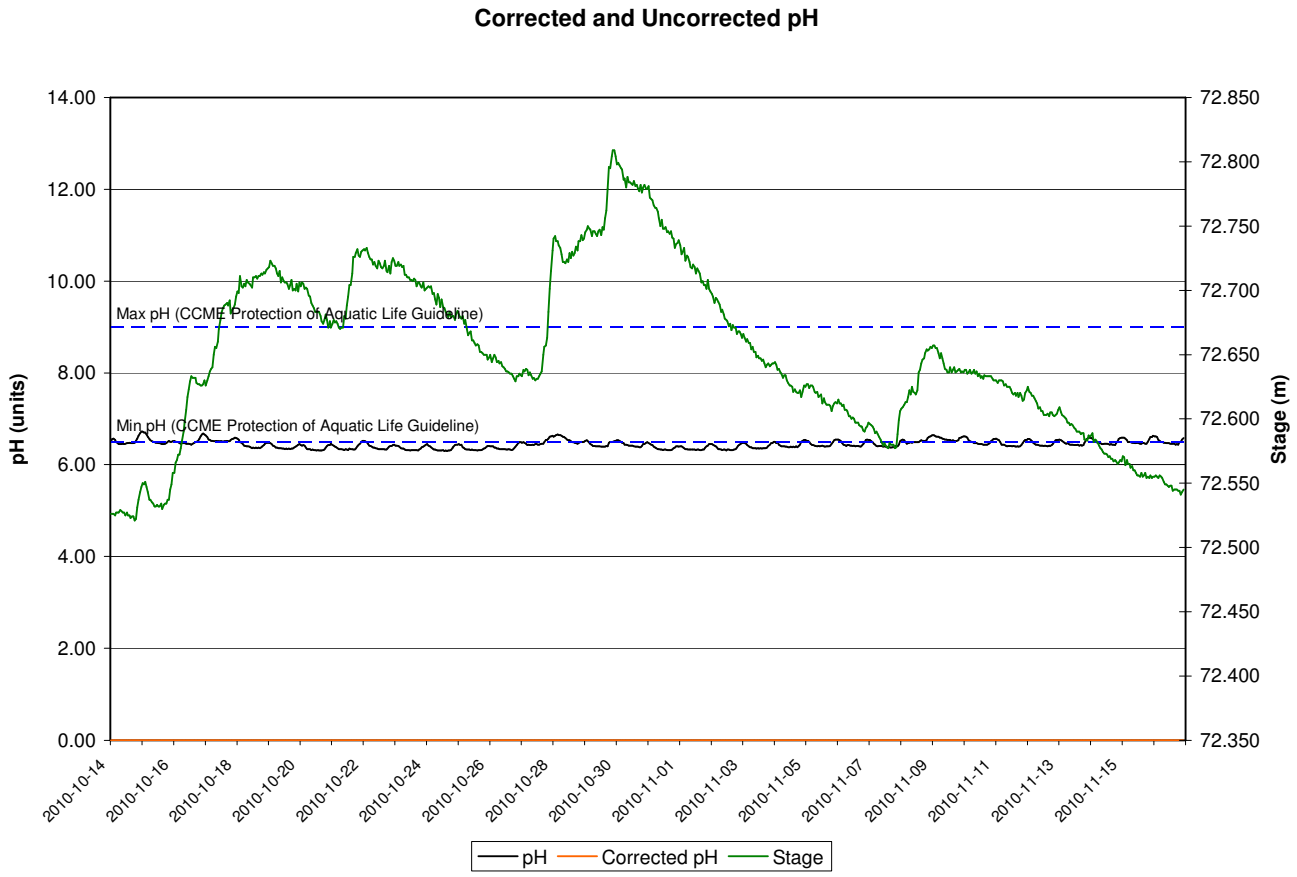
- No correction to water temperature was required since the total error for the station did not exceed the data correction criterion.
- Rattling Brook below Plant Discharge expressed a similar development in water temperature in the time series below. A pattern of falling temperature is punctuated by two instances of warming periods: one mid-deployment and another in the latter third of deployment.
- Because this station is further downstream from Big Pond and below Bridge stations, it is given more time for influence by changing air temperatures. The outcome is a greater degree of variation and range in temperatures. Water temperature ranged from 12.70 to 4.34^{o}C for with a median value of 8.89^{o}C.

Figure 11: Water Temperature at Rattling Brook below Plant Discharge from October 14 to November 17, 2010



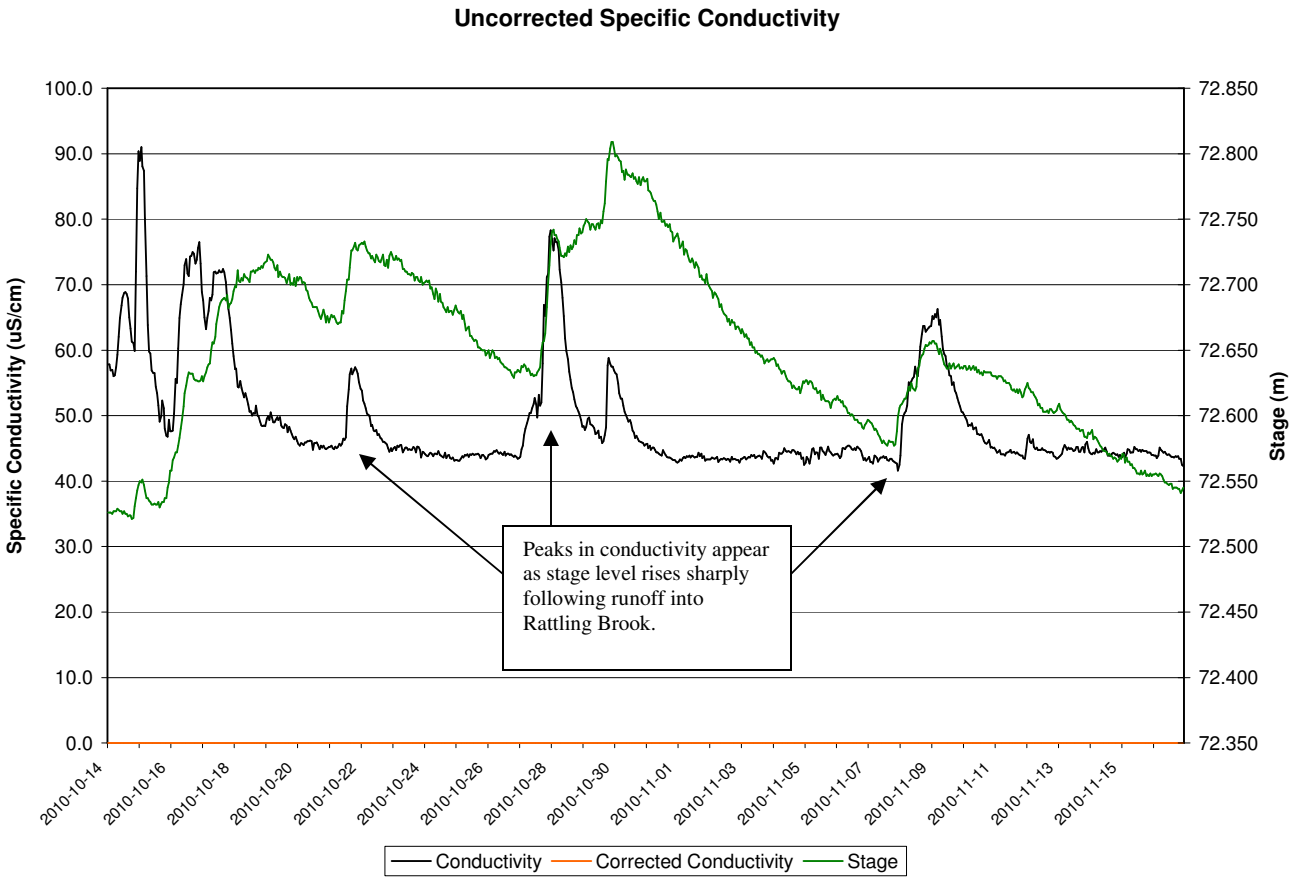
- No correction was applied to pH at Rattling Brook below Plant Discharge as the total error did not exceed the data correction criterion at the end of deployment.
- pH appeared to be fairly stable in the time series below with values hovering at or just below the CCME Guideline of 6.5 for the protection of aquatic life. Values ranged from 6.30 to 6.72 for the month with a median value of 6.44 units. Therefore, more than 50% of records were below the guideline.
- Guideline exceedences are expected in this region of the province due to geochemical factors. Work on site-specific guidelines is ongoing.

Figure 12: pH at Rattling Brook below Plant Discharge from October 14 to November 17, 2010



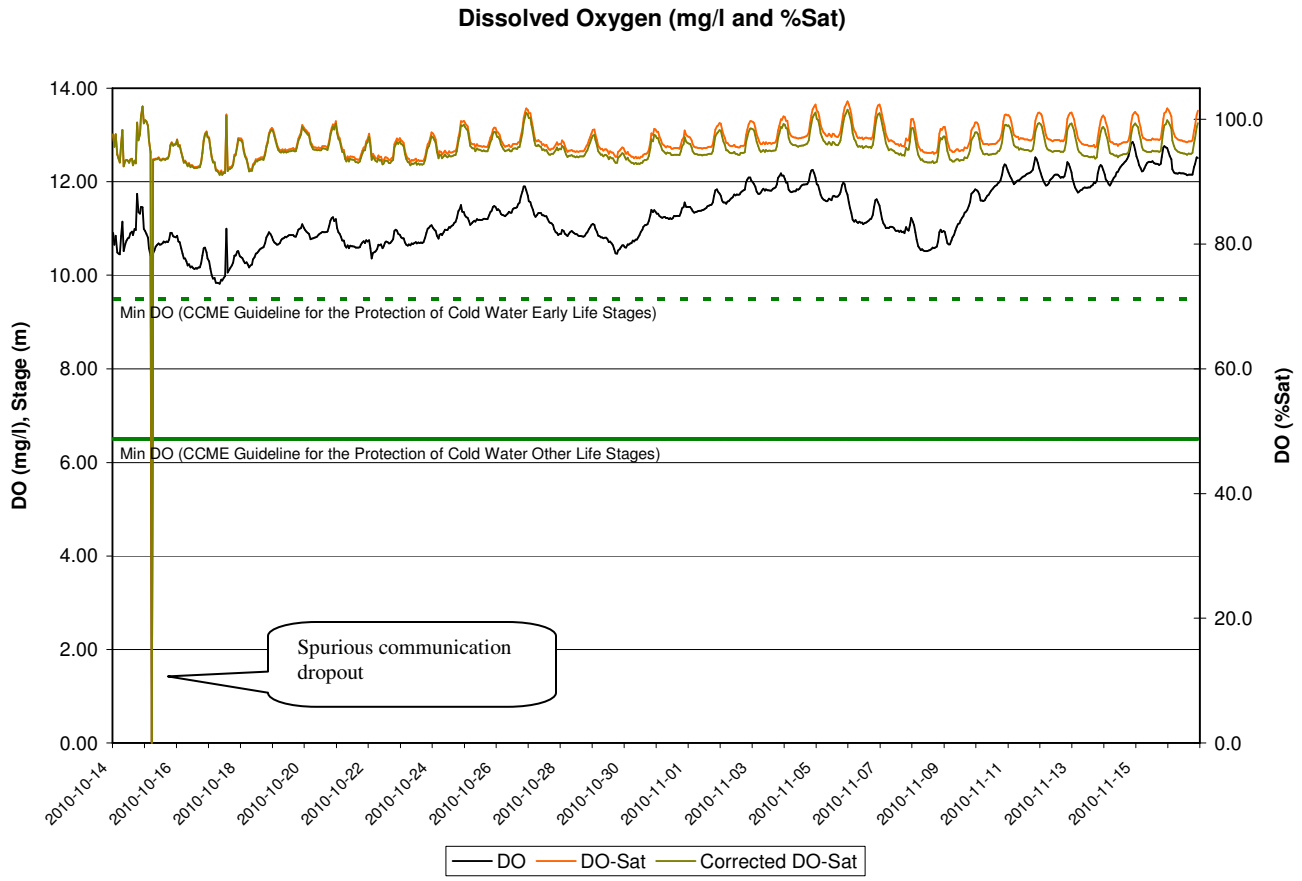
- No correction was made to specific conductivity at Rattling Brook below Plant Discharge during this deployment interval.
- A series of rounded peaks were recorded in specific conductivity throughout the deployment period, especially in relation to precipitation events. Conductivity ranged from 41.6 to 91.0 µS/cm with a median value of 45.1 µS/cm. No obvious trend is detected in conductivity.

Figure 13: Specific Conductivity at Rattling Brook below Plant Discharge from October 14 to November 17, 2010



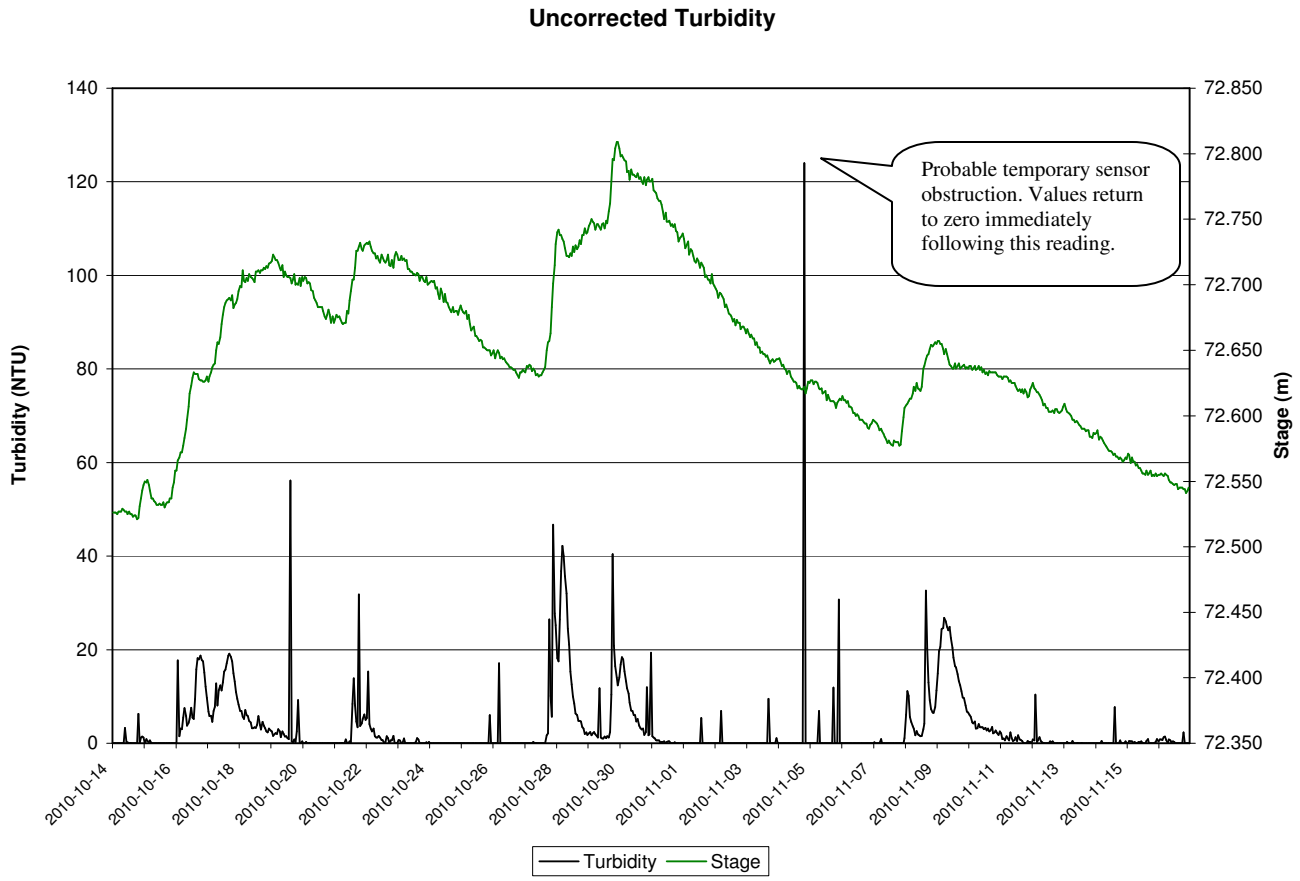
- Dissolved oxygen saturation ranged from 91.3 to 102.9% for during this interval. The deployment maximum of 102.9% was reached on November 6th at 12:30pm. This day was also the warmest in terms of mean air temperature. No precipitation was recorded on this day, therefore, it should be assumed that the warm air temperature spurred an increased net production of oxygen in the water column.
- The concentration of oxygen ranged from 9.82 to 12.85 mg/l with a median value of 11.20 mg/l. All values were found to be greater than the CCME Guideline of 9.5 mg/l for the protection of Early Life Stage cold water biota. A general upward trend is observed in relation to the cooling river water.

Figure 14: Dissolved Oxygen at Rattling Brook below Plant Discharge from October 14 to November 17, 2010



- Turbidity at Rattling Brook below Plant Discharge station is more variable and prone to fluctuation since Hurricane Igor. Bank stability on Rattling Brook has been impaired and silt release into the river channel is now much more common since before September 21st.
- Turbidity ranged from 0.0 to 124.0 NTU with a median value of 0.0 NTU. This indicates that, despite highly variable turbidity measurements, at least 50% of recordings are zero turbidity.
- A spike of 124.0 NTU on November 5 at 8:30 am. This value is most likely an outlier point since the records for 10 hours before and after this reading are 0 NTU. The spike is probably the result of a temporary obstruction on the sensor.

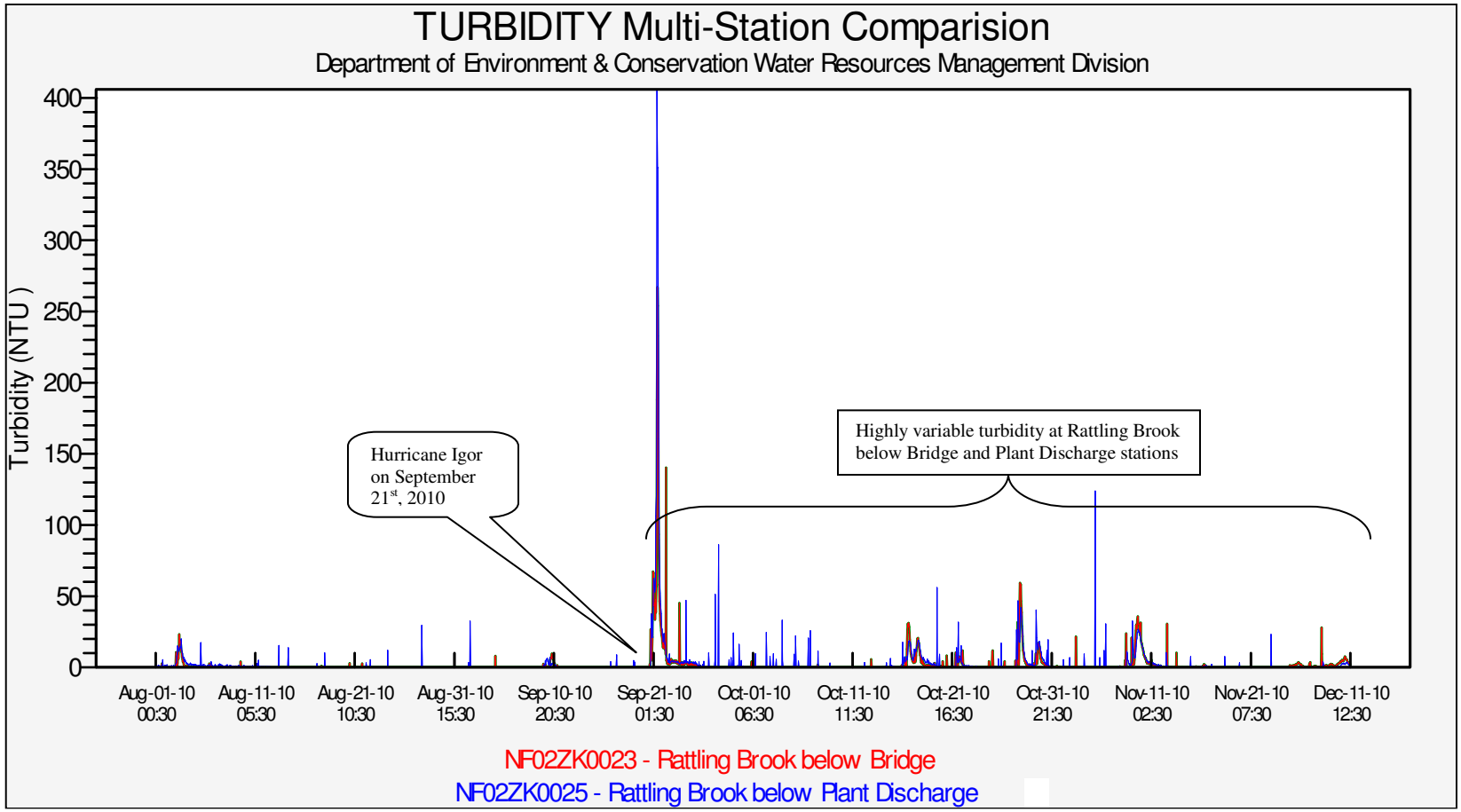
Figure 15: Turbidity at Rattling Brook below Plant Discharge from October 14 to November 17, 2010

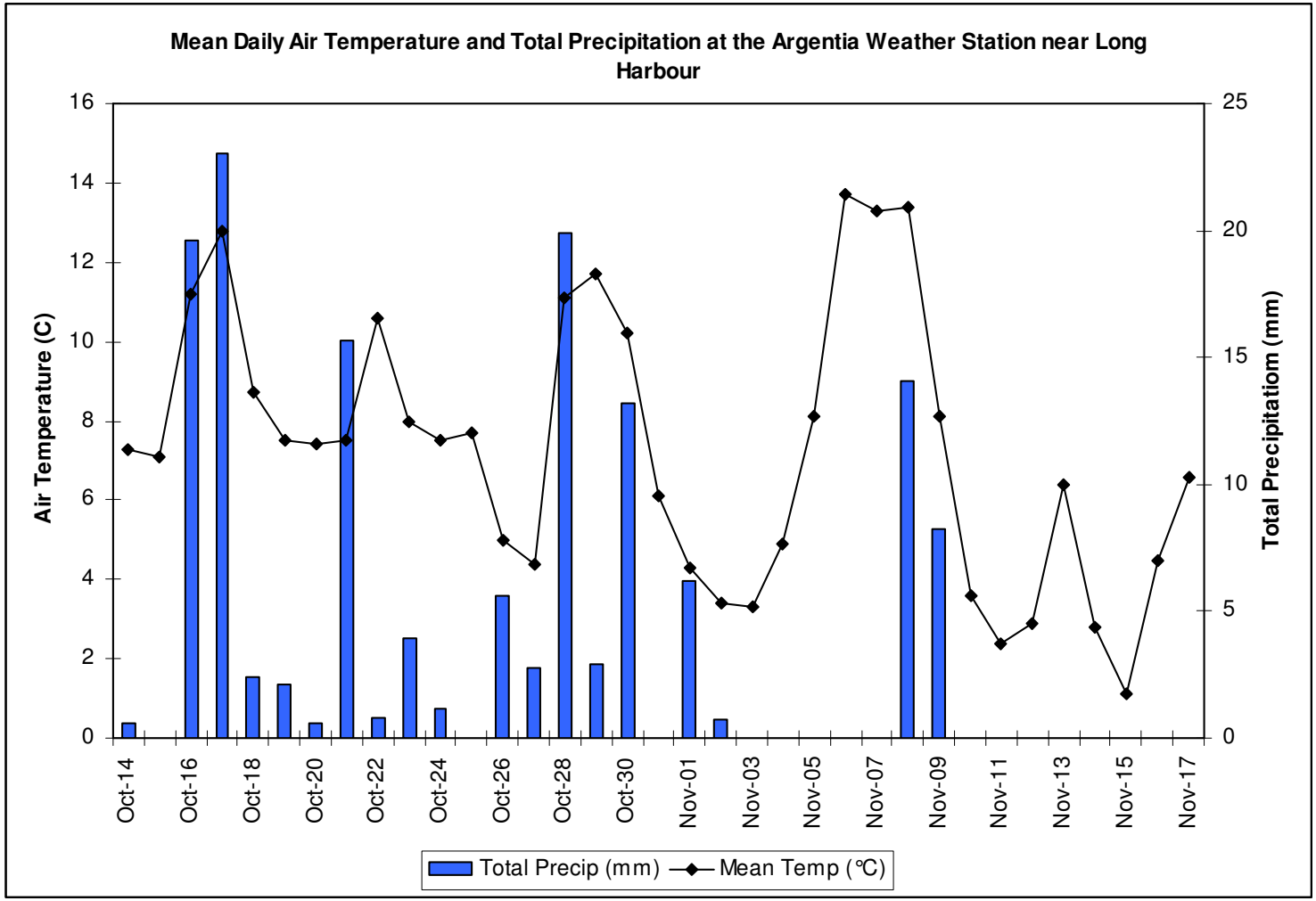


Conclusions

- All three stations functioned well during this deployment period with only a single communication dropout occurring during the deployment.
- No major water quality events were recorded that warrant concern. All parameters are within expected ranges for this time of the year.
- Turbidity has become much more variable and prone to fluctuation since Hurricane Igor on September 21st, 2010. Extreme flow and water level has impaired bank stability on Rattling Brook by removing shrubs and grass that holds soil. At the Rattling Brook below Plant Discharge station, a large bush is absent and a large rocky crater remains. See the Appendix for a figure depicting the turbidity before and after Hurricane Igor.

Appendix


TURBIDITY Multi-Station Comparision
Department of Environment & Conservation Water Resources Management Division
Turbidity (NTU)
400
350
300
250
200
150
100
50
0
Hurricane Igor on September 21st, 2010
Highly variable turbidity at Rattling Brook below Bridge and Plant Discharge stations
Aug-01-10 00:30
Aug-11-10 05:30
Aug-21-10 10:30
Aug-31-10 15:30
Sep-10-10 20:30
Sep-21-10 01:30
Oct-01-10 06:30
Oct-11-10 11:30
Oct-21-10 16:30
Oct-31-10 21:30
Nov-11-10 02:30
Nov-21-10 07:30
Dec-11-10 12:30
NF02ZK0023 - Rattling Brook below Bridge
NF02ZK0025 - Rattling Brook below Plant Discharge



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